ECONOMIC GEOLOGY IN THE UNITED STATES.

THE energy shown by all branches of the United States Geological Survey increases year by year, and it is impossible to overestimate the importance of the results achieved during the twenty-five years of its existence. The prompt return made for the pecuniary support accorded to the survey is best shown by the numerous publications, appearing each year, which are devoted to the development of the mineral resources and to the advancement of

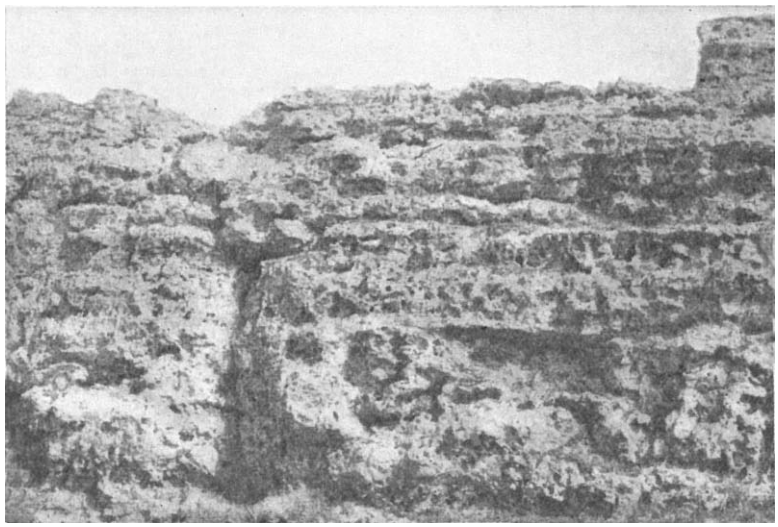

FIG. 1.—Weathered Surface of Galena Limestone near Rockdale, Iowa.

important engineering projects. The miner is thus taught the practical value of geological work, and mining development is placed upon a scientific basis. A large number of bulletins have recently been published which, though describing researches of an essentially scientific nature, deal with the economic resources of specified districts. Half a dozen of these bulletins, well illustrating the educational value of the survey's work to those engaged in the mining industry, have been selected for brief notice. Of these the most important is No. 260, "Contributions to Economic Geology, 1904," in which Mr. S. F. Emmons and Mr. C. W. Hayes, the geologists in charge of the sections dealing with ores and non-metallic minerals respectively, bring before the public with all possible speed the economic results arrived at by the survey. The bulletin covers 620 pages, and contains sixty-three contributions from thirty-seven members of the survey who have been engaged throughout the year in economic work. The production of gold and silver in the United States in 1904 is discussed by Mr. W. Lindgren, who has made a novel classification of the ores into (1) placer or detrital deposits, and (2) ores from rock *in situ*, further subdivided into quartzose ores, copper ores, and lead ores. The percentage of the total production derived from the four classes thus established is as follows:—

	Placers	Quartzose	Copper	Lead
Gold	15·2	74·3	5·0	5·4
Silver	0·1	22·2	34·7	42·9

A similar calculation of the copper production of the United States, made by Mr. W. H. Weed, shows that of the copper produced 27 per cent. occurs in native ores, 6 per cent. in oxide ores, and 67 per cent. in sulphide ores. Mr. L. C. Gratton reports that the tin deposits (dykes of pegmatite carrying cassiterite) of North and South Carolina are probably of considerable economic importance; and Mr. F. L. Hess gives a concise statement of what is known with regard to tin deposits throughout the rest of the world. In the Birmingham district, Alabama, an important result of the work of the survey has been the extension of the red hæmatite ore beyond its supposed southern limit.

The fuel resources of the United States received more attention last year than at any previous time during the existence of the survey. About 3000 square miles of coal-bearing territory have been mapped, and work in the oil and gas fields has been continued. The American cement industry formed the subject of an extensive investigation by Mr. E. C. Eckel, and much valuable information is given regarding the slate, granite, and clay industries. Descriptions are also given of a molybdenite deposit in eastern Maine, and of the vanadium and uranium ore deposits in south-eastern Utah.

Bulletin No. 255, on the fluorspar deposits of southern Illinois, by Mr. H. Foster Bain, embodies the results obtained in a detailed study of the fluorspar deposits in Pope and Hardin counties, the area covered being at present one of the most important producers of fluorspar in the United States. The deposits were discovered in 1830, but were not mined until 1870. The mineral occurs in veins along faulting fissures, and is associated with calcite, galena, and zinc-blende. In 1903 the district produced 11,413 tons of fluorspar, valued at 11,544*l*. The best grade of fluorspar, with less than 1 per cent. of silica, is used in the enamelling, chemical, and glass trades. The second grade is used in open-hearth steel making to give fluidity to the slag. About 20,000 tons are used annually in this work. The lowest grade is used in foundry work.

The zinc and lead deposits of north-western Illinois are dealt with in Bulletin No. 246 by Mr. H. Foster Bain. The region contains large reserves of zinc ore of good quality. The main ore-bearing rock is a thick massive dolomite, known as the galena limestone. Owing to the predominance of solution over disintegration, it presents on

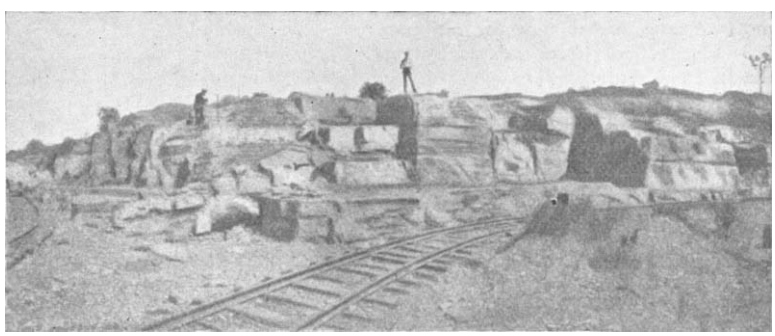

FIG. 2.—Vanport Limestone Quarries at Newcastle, Pennsylvania.

weathered surfaces a very characteristic carious surface (Fig. 1).

Bulletin No. 249, on limestones of south-western Pennsylvania, by Mr. F. G. Clapp, is of great economic interest in view of the recent extension of the portland cement industry. It points out promising localities for the erection of cement plants in the coal areas of Pennsylvania. As a rule, these Carboniferous limestones are not suited for building stone, but many of them, when burned, form lime of excellent quality for agricultural, building, and fluxing purposes. The Vanport limestone, the most per-

sistent, thickest, purest, and most massive limestone in the series, is extensively quarried for furnace flux at Newcastle (Fig. 2).

In Bulletin No. 238 Messrs. G. I. Adams, E. Haworth, and W. R. Crane give detailed information concerning the geology of the Iola Quadrangle, Kansas, a rapidly developing petroleum and natural gas field. At the end of 1903 there were 1596 producing wells in Kansas, and of these 549 were at Chanute (Fig. 3) and 339 at Humboldt in the area under consideration. Natural gas is abundant in the vicinity, and is largely used in zinc smelting. Indeed, more than half the zinc made in the United States is smelted by Kansas gas, and more than half of this is produced at works within the Iola quadrangle.

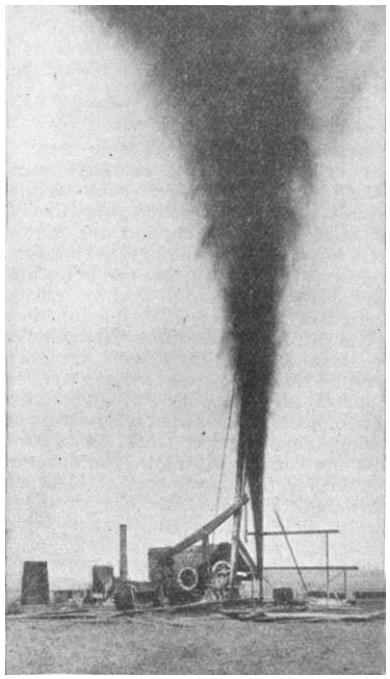

FIG. 3.—Golden Oil Company's Well No. 2, near Chanute, Kansas.

Bulletin No. 264, by Messrs. M. L. Fuller, E. F. Lines, and A. C. Veatch, gives a record of deep-well drilling for 1904, and is the first of a proposed series of annual publications. The report embodies the records of a large number of wells, for many of which sets of samples are preserved.

THE APPLICATION OF SCIENTIFIC METHODS TO THE STUDY OF HISTORY.[1]

THE remarkable change which during the last fifty years has passed over most subjects of study owing to the growing dominance of the scientific spirit has not left history unaffected. The leading historians of the present day are essentially men of science. They are diligent in their pursuit of truth and skilled in the special methods of research which their subject demands. They are strikingly impartial in their judgments, constantly on their guard against the prepossessions so liable in matters of past politics to bias opinion. They are ever on the alert to discover unifying principles, general laws, large uniformities, without which no body of historic facts, however accurately ascertained and however impassionately selected, can justify the claim of history to be regarded as a science, or can make history worthy of the serious attention of intelligent men.

All the writers enumerated at the foot of this column deal in some shape or form with this transference of history from the domain of literature to the domain of science. None states the fact of the transference more clearly than does Prof. Bury, who says (p. 16):—"I may remind you that history is not a branch of literature. The facts of history, like the facts of geology or astronomy, can supply material for literary art . . . but to clothe the story of a human society in a literary dress is no more the part of a historian as a historian, than it is the part of an astronomer as an astronomer to present in an artistic shape the story of the stars"; and again (pp. 7 and 42) he emphatically asserts that "History is a science, no less and no more." But though this statement is perhaps more explicit than any other in the works before us, yet the idea which it expresses is common to all.

It is not enough, however, to assert that a subject, long regarded as a branch of literature, is really a science. It is necessary to define its scope, to expound its method, and to show its relation to other sciences. This our authors do in varying degrees of fulness, and it would be a profitable, and I think not uninteresting, task to take them one by one and to analyse their views. But in an article like the present it is not possible to undertake this detailed examination, and I must content myself with giving a summary statement of the way in which scientific method has been applied to history, and of some of the results which have been attained.

It is a curious and remarkable fact that the earliest of the above-named exponents of the science of history, Droysen and Froude, were called upon to cast their first clear utterances upon the subject into the form of a severe castigation of a too zealous champion of their own view, H. T. Buckle. Buckle had become possessed of the great idea commonly associated with the name of Comte, viz. that "all phenomena without exception are governed by invariable laws with which no volitions natural or supernatural interfere," and in his "History of Civilisation" (1858–61) he had endeavoured with wonderful ingenuity and vast learning, not so much to elevate history to the rank of a science as to reduce it to the level of a *physical* science, with laws of the same rigidity and of the same universal applicability as the laws of motion or the laws of chemical affinity. This was going further than either the most advanced historians or the least exclusive philosophers would allow, and a keen controversy ensued, out of which at length emerged into general recognition the important fact that history differs from the natural sciences in at least two respects, first, that, with regard to its method, it is a science, not of observation or of experiment, but of criticism; secondly, that with respect to its generalisations, since they deal with a realm, not of matter, but of mind, in which motive and not force is supreme—a realm of consciousness and freedom—they can never have that fixity and universality which are connoted by the term "law."

On the other hand, historical phenomena are not permanent, but evanescent. Events happen once, and then fade beyond recall into the past. Observations made at the moment of their happening can never be repeated, and historians are dependent for all their knowledge of bygone events upon such records as may chance to have been made and to have been preserved. These records are the only present and concrete facts with which historians come into contact. These are the basal material of their science. But they are valuable and important, not at all for their own sake, but only for what they reveal. They reveal past facts, yet even these not directly, but past facts as seen through the refracting medium of the human mind. And when the historian has eliminated, so far as he can, the personal factors for his records and has extracted such pure and unadulterated fact as remains, even then he has not come to the end of his research. Far beyond and beneath all events there lie the thoughts, the acts of will, the emotions of which they were the realisations and manifestations—ultimate facts of the human spirit wholly beyond the observation even of those in whose midst the events transpired. It is these for which in the last resort he seeks. Thus, as has been remarked, history is a science, not of observation, still less of experiment: it is a science of criticism.

On the other hand, with regard to generalisation and law, the fundamental truth to be recognised is that history never repeats itself. The phenomena of history are not

[1] (1) "Erhebung der Geschichte zum Rang einer Wissenschaft." By J. G. Droysen. (1862.)
(2) "The Science of History." By J. A. Froude. (1864.)
(3) "Grundriss der Historik." By J. G. Droysen. (1867.)
(4) "The Science of History." By Principal John Caird. (1886.)
(5) "Introduction aux Études Historiques." By Langlois and Seignobos. (1897.)
(6) An Inaugural Lecture. By Prof. J. B. Bury. (1903.)
(7) "A Plea for the Historical Teaching of History." By Prof. C. H. Firth. (1904.)
(8) "The Methodical Study of Man." By Dr. Percy Gardner. (1904.)